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Roseville Rail Yard Study

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Roseville Rail Yard Study

Contributing Authors

Ron Hand
Pingkuan Di, Ph.D., P.E.
Anthony Servin, P.E.
Larry Hunsaker, P.E.
Carolyn Suer

Reviewed by

Daniel E. Donohoue, Chief
Emissions Assessment Branch
Peggy Taricco, Manager
Technical Analysis Section

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City of Roseville Community Development Department: Dorothee A. Moss

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Roseville Rail Yard Study Part I: Risk Characterization

Risk Characterization
for the Union Pacific Railroad's J.R. Davis Yard
Roseville, California

INTRODUCTION

The California Air Resources Board (ARB or Board) conducted a health risk assessment of airborne particulate matter emissions from diesel-fueled locomotives at the Union Pacific J.R. Davis Yard (Yard) located in Roseville, California. The results from that evaluation are presented in this report which is comprised of two parts. Part I, Risk Characterization for the Union Pacific Railroad's J.R. Davis Yard Roseville, California, provides a less technical and more easily understood explanation of health risk assessment results. It also is intended to explain what the risk assessment results mean and to put the results in perspective with other related environmental and public health risks. Part II, Health Risk Assessment for the Union Pacific Railroad's J.R. Davis Yard Roseville, California, provides a detailed assessment of the potential health risk near the Yard due to diesel particulate matter (diesel PM) emissions from locomotives.

BACKGROUND

The Placer County Air Pollution Control District (District) requested help from the ARB in determining the potential public health risks from diesel PM emissions due to locomotive activities at the J. R. Davis Yard (rail yard or Yard) in Roseville, California. Roseville is a rapidly growing area and development over the past several years has put more residences in close proximity to the rail yard. With an increasing population near the Yard, complaints regarding the rail yard operations and concerns about possible health risks have been raised. The rail yard is situated near the heart of Roseville, encompassing about 950 acres on a one-quarter mile wide by four-mile long strip of land that parallels Interstate 80. The Yard is bounded by commercial, industrial, and residential properties. The Yard is the largest service and maintenance rail yard in the West with over 30,000 locomotives visiting annually.

FINDINGS AND RECOMMENDATION

To summarize, the key findings of the study are:

- The diesel PM emissions in 2000 from locomotive operations at the Yard are estimated to be about 25 tons per year.
- Moving locomotives account for about 50 percent, idling locomotives account for about 45 percent, and locomotive testing accounts for about 5 percent of the total diesel PM emissions at the Yard.
- Computer modeling predicts potential cancer risks greater than 500 in a million (based on 70 years of exposure) northwest of the *Service Track* area and the *Hump*

and Trim area. The area impacted is between 10 to 40 acres. To provide some perspective on the size, an acre is about the size of a football field.

- The risk assessment show elevated concentrations of diesel PM and associated cancer risk impacting a large area. These elevated concentrations of diesel PM, which are above the regional background level, contribute to an increased risk of cancer and premature deaths due to cardiovascular disease and non cancer health effects such as asthma and chronic obstructive pulmonary disease. Potential cancer risk and the number of acres impacted for several risk ranges are as follows:
  - ✓ Risk levels between 100 and 500 in a million occur over about 700 to 1,600 acres in which about 14,000 to 26,000 people live.
  - ✓ Risk levels between 10 and 100 in a million occur over a 46,000 to 56,000 acre area in which about 140,000 to 155,000 people live.

- The magnitude of the risk, the general location of the risk, and the size of the area impacted varies depending on the meteorological data used to characterize conditions at the Yard, the dispersion characteristics, and the assumed exposure duration and breathing rate for the proposed population.

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- Given the magnitude of diesel PM emissions and the large area impacted by these emissions, short term and long term mitigation measures are needed to significantly reduce diesel PM emissions from the J.R. Davis Rail Yard.

RISK ASSESSMENT RESULTS

A risk assessment uses mathematical models to evaluate the heath impacts from exposure to certain chemicals or toxic air pollutants released from a facility or found in the air. In order to perform the risk assessment, data was needed on the levels or concentrations of the diesel PM. At this time, there is no monitoring technique that allows scientists to directly measure diesel PM in the air. In order to estimate the concentrations of diesel PM, an emissions inventory was developed and an air dispersion model was then used to estimate the resulting concentration of diesel PM in the air. The air dispersion model uses a variety of information, such as the amount of pollutant emissions, weather or meteorology data, and the location and height of the emissions release, all of which can greatly affect the final results. A detailed description of how the risk assessment was done, including all of the supporting technical data and results, can be found in Part II of this report, *Health Risk Assessment.*

*A **risk assessment** is a tool used to evaluate the potential for a chemical or pollutant to cause cancer and other illnesses.*

In a risk assessment, risk is expressed as the number of chances in a population of a million people who might be expected to get cancer over a 70-year lifetime. However, for informational purposes only, the risk is sometimes reported for other exposure times, such as a 30-year or a 9-year risk. The longer the exposure, the greater the risk will be. In this part, only the 70-year lifetime risk is presented. Information on risk levels associated with 30-year exposures are presented in Part II. This analysis focuses on potential cancer cases due to exposure to diesel PM emissions. However, there is a growing body of scientific data suggesting that exposure to fine particulate matter may be responsible for premature death and morbidity (illness) due to respiratory and cardiovascular disease. The sensitive subpopulations include people with pre-existing cardiovascular disease and respiratory disease, including asthma, particularly those who are also elderly. The overall noncancer mortality from diesel PM exposure may exceed the cancer mortality by a considerable amount. The levels of exposure to diesel PM from the estimated emissions of diesel PM at the Yard were calculated using two meteorological data sets (Roseville and McClellan) and for both urban and rural dispersion characteristics in the air dispersion model. Two meteorological data sets were used because there are no direct meteorological measurements at the yard, and there is some uncertainty about the representativeness of both the Roseville and McClellan data sets. The use of the two sets provides the best estimate of the expected range of levels or concentrations of diesel PM around the rail yard. Dispersion characteristics refer to the type of land use, such as whether there are buildings near-by or open fields. Both urban and rural dispersion characteristics were used because the land uses around the rail yard have properties of both. The predicted diesel PM concentrations near the Yard (within one mile) were estimated using urban dispersion characteristics, while diesel PM concentrations greater than one mile from the Yard were predicted using rural dispersion characteristics. This was done in order to simplify the presentation of the results while still providing a reasonable estimate of possible exposures. In the discussion below, the results based on the various predicted concentrations are presented.

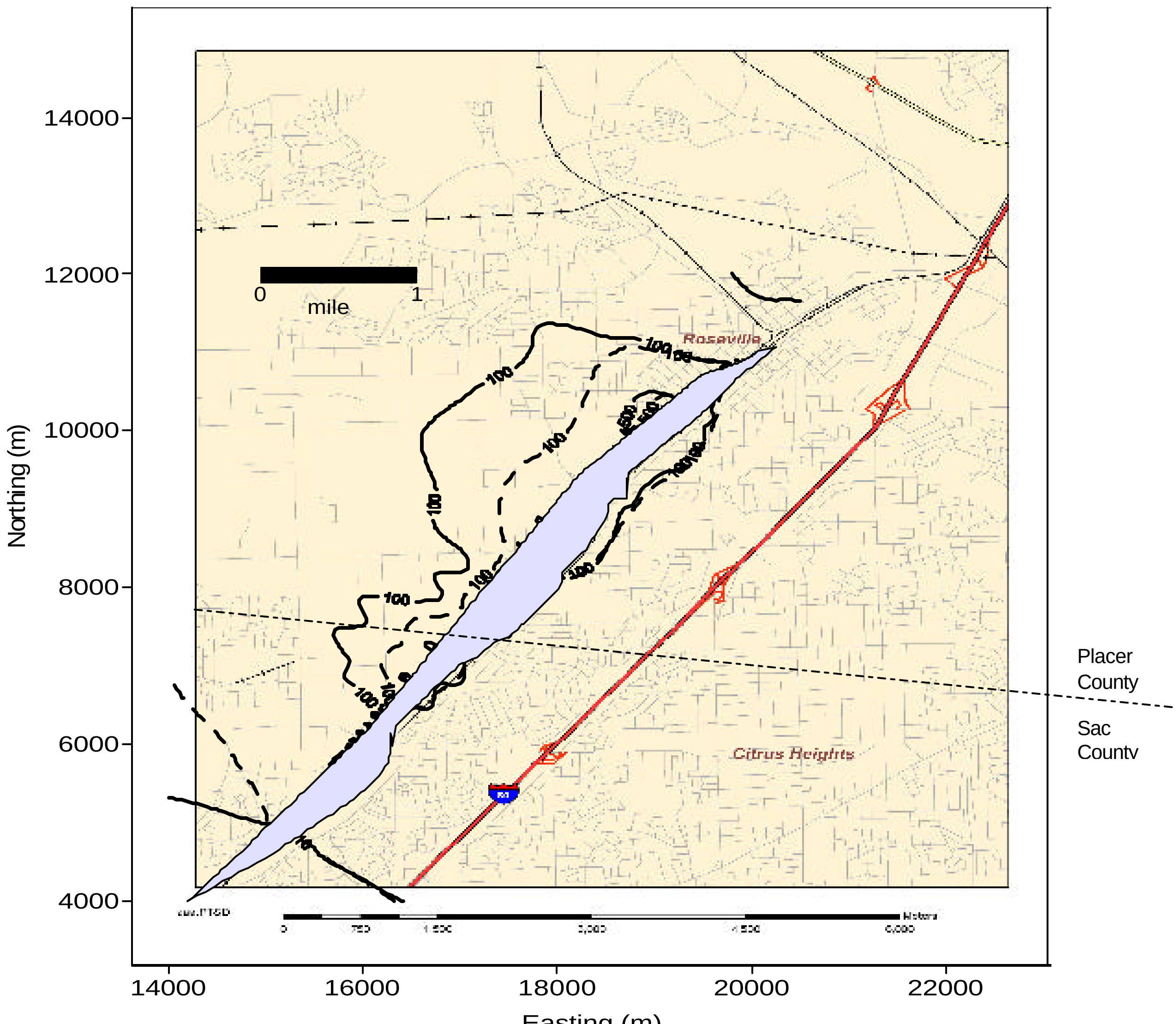
*For **cancer** health effects, the risk is expressed as the number of chances in a population of a million people who might be expected to get cancer over a 70-year lifetime. The number may be stated as "10 in a million" or "10 chances per million". Often times scientific notation is used and you may see it expressed as 1 x 10^{-5} or 10^{-5}. Therefore, if you have a potential cancer risk of 10 in a million, that means if one million people were exposed to a certain level of a pollutant or chemical there is a chance that 10 of them may develop cancer over their 70-year lifetime. This would be 10 new cases of cancer above the expected rate of cancer in the population. The expected rate of cancer for all causes, including smoking, is about 200,000 to 250,000 chances in a million (one in four to five people).*

<u>Estimated Potential Cancer Risk</u>

Figure 1 and Figures 2a and 2b present the estimated potential cancer risk levels due to diesel PM emissions at the Yard. For this analysis, staff elected to present the cancer risk data as risk concentration isopleths focusing on risk levels of 10, 25, 50, 100, and 500 in a million. Figure 1 focuses on the near source risk levels and Figure 2a and 2b focus on the more regional impacts. In each figure, the risk isopleths are overlaid onto a map of the Roseville area surrounding the Yard. The solid isopleth lines are based on the Roseville meteorological data and the dashed isopleth lines are based on the McClellan meteorological data.

Figure 1 shows the 100 and 500 in a million risk isopleths. As shown, the areas with the greatest impact have an estimated potential cancer risk of over 500 in a million. Depending upon the meteorological data set, and using urban dispersion characteristics, the areas exceeding 500 in a million ranges between 10 to 40 acres. The primary area with risks estimated above 500 in a million is shown in the center of Figure 1 toward the top of the Yard on the left. This off-site area is adjacent to the *Service Track* area which includes the maintenance shop. The high concentration of diesel PM emissions is due to the number of locomotives and the nature of activities in this area, particularly idling locomotives. The second area with risk estimates above 500 in a million is shown in Figure 1 just south of the county line and to the left of the Yard. This offsite area is adjacent to the *Hump and Trim* area. Based on the 2000 U.S. Census Bureau's data, between 500 and 700 Roseville residents live in these areas.

Figure 1
Estimated Cancer Risk from the Yard
(100 and 500 in a million risk isopleths)



Notes: Solid Line = Roseville Met Data; Dashed Contour Lines = McClellan Met Data; Urban Dispersion Coefficient, 80th Percentile Breathing Rate, All Locomotive's Activities [23 TPY], Modeling Domain = 6km x 8km, Resolution = 50m x 50m

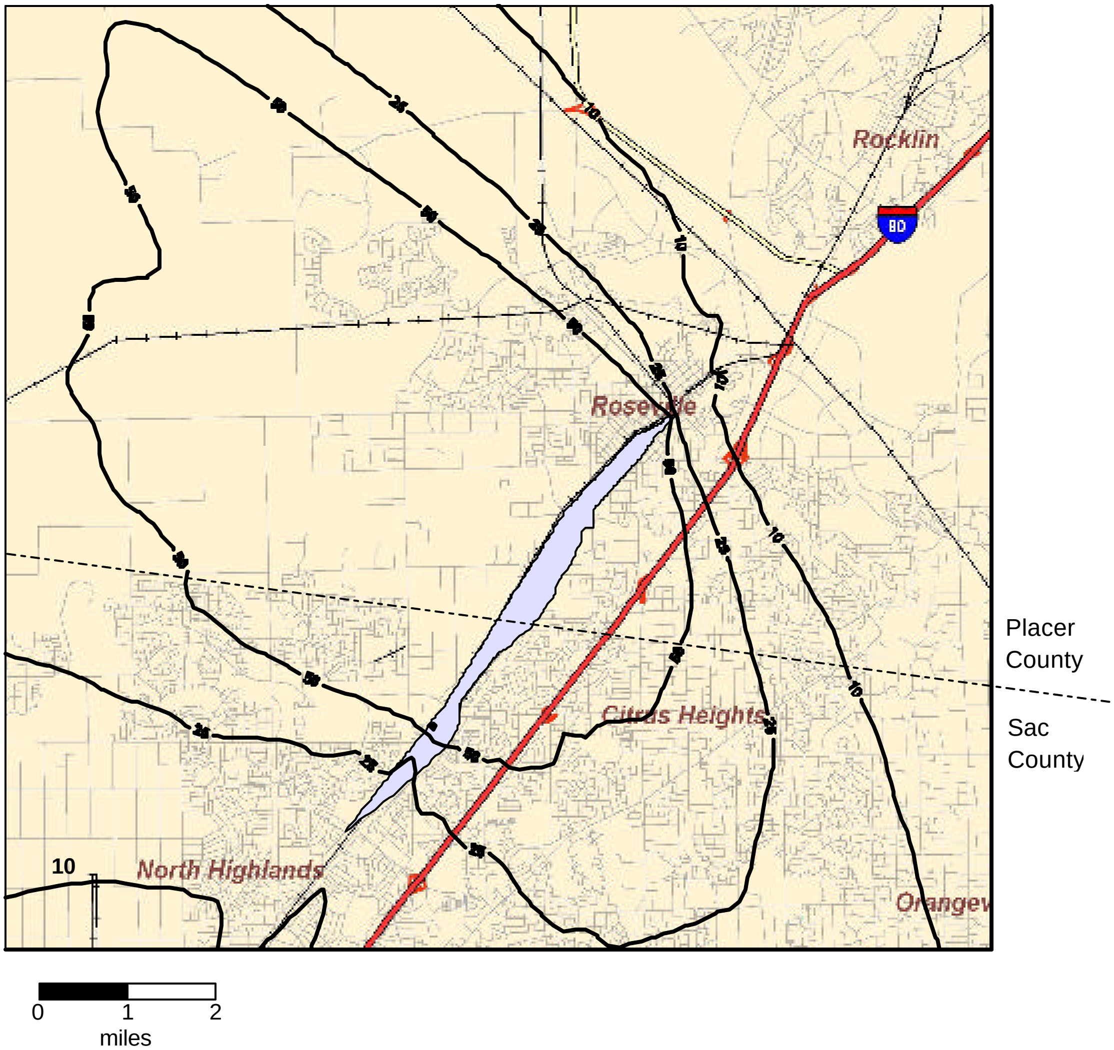
The second area of impact, with an estimated potential cancer risk of 100 to less than 500 in a million, ranges between 700 to 1600 acres. Again, the size of the area of impact is highly dependent upon the meteorological data set used. The area of impact is primarily to the north west of the Yard. Based on the 2000 U.S. Census Bureau's data, between 14,000 and 26,000 residents live in this area.

Figures 2a and 2b show the area where the predicted cancer risk exceeds 10, 25, and 50 in a million. Figure 2a displays the results using the Roseville meteorological data. As shown in figure 2a, the elevated risk levels are primarily to the northwest of the Yard (predominate wind direction) and decreases as the distance from the Yard increases. The largest area of impact has an estimated potential cancer risk of greater than 10 in a million. This area encompasses approximately 46,000 acres. The contour lines of 10 in a million are broken because the risk levels do not fall below 10 in a million within the model domain. In other words, the 10 in a million isopleth goes well beyond the boundaries of the figure. Based on the 2000 U.S. Census Bureau's data, about 140,000 people live in the 10 to 100 in a million isopleth shown on the figure and within the model domain.

Figure 2b shows the risk isopleths using the McClellan meteorological data. Again, the 10 in a million isopleth goes well beyond the boundaries of the figure. The area between the 10 and 100 in a million isopleth encompasses approximately 55,000 acres where an estimated 155,000 residents live.

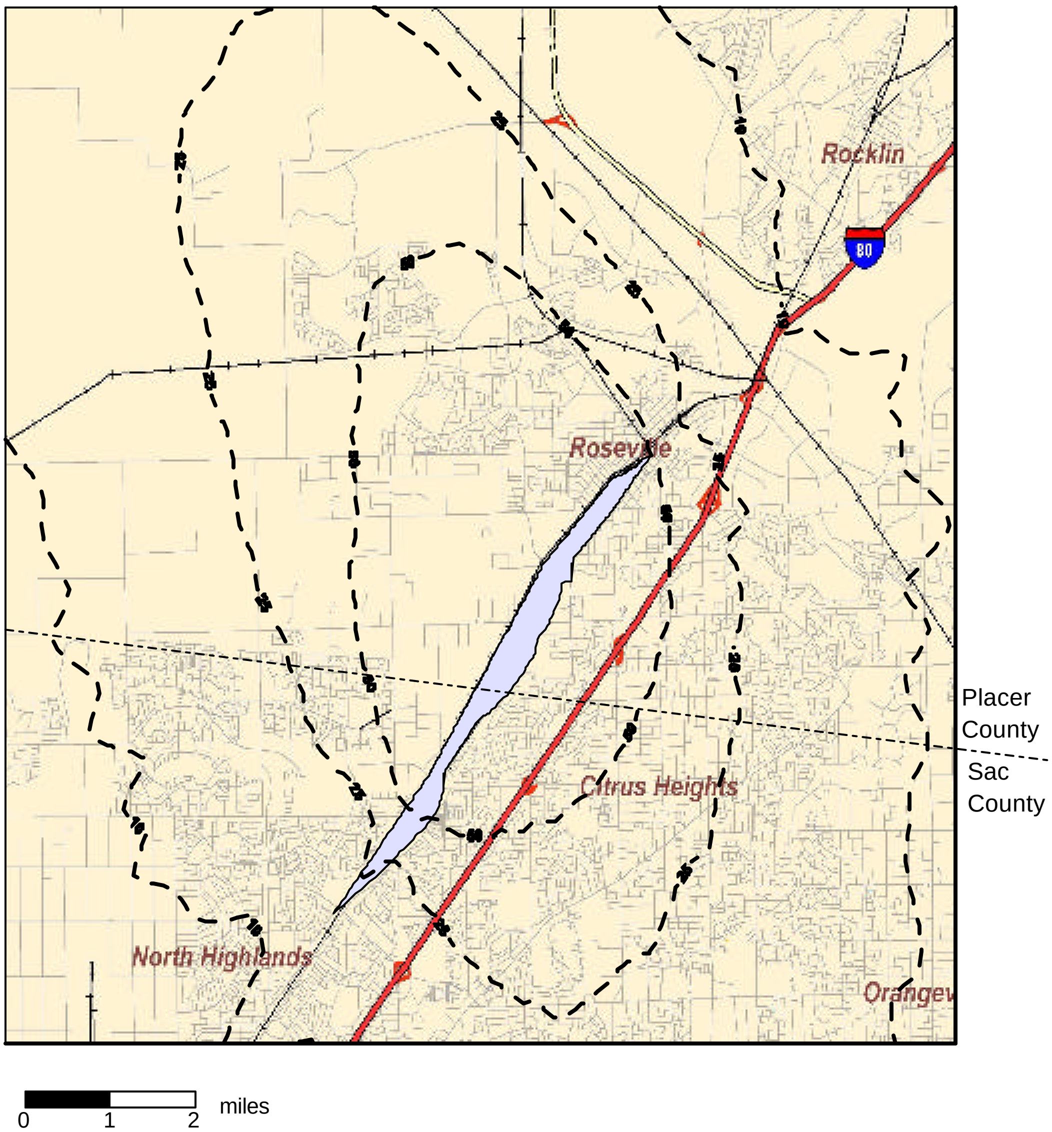
What these results indicate is that the diesel PM emissions from the rail yard are widely dispersed out over the greater Roseville area at levels that pose a cancer risk concern. It is important to understand that these risk levels represent the predicted risk due to diesel PM above the existing background risk levels. For the broader Sacramento region the estimated background risk level from diesel PM is estimated to be 360 in a million for diesel PM and 520 in a million for all toxic air pollutants.

Figure 2a
Estimated Cancer Risk from the Yard Using Roseville Met Data
(10, 25, and 50 in a million risk isopleths)



Note: Roseville Meteorological Data, Rural Dispersion Coefficients, 80th Percentile Breathing Rate, All Locomotives' Activities [23 TPY], 70-Year Exposure

Figure 2b
Estimated Cancer Risk from the Yard Using McClellan Met Data
(10, 25, and 50 in a million risk isopleths)



Note: McClellan Meteorological Data, Rural Dispersion Coefficients, 80th Percentile Breathing Rate, All Locomotives' Activities [23 TPY], 70-Year Exposure

Risk Comparisons

To put the risk assessment numbers into perspective, it is helpful to view them in comparison to other risks due to exposure to air pollution. For example, the estimated risk from toxic air contaminants statewide, based on being exposed to an average annual concentration for 70 years is about 750 chances in a million. This number is based on an average concentration of toxic air pollutants measured by the ARB's monitoring network and the estimated risk for diesel particulate matter based on exposure estimates. The risk in various regions can vary considerably. For example, the average risk in some parts of the Los Angeles area are well over 1,000 chances in a million, while the average regional risk in a less industrialized area like Roseville, is closer to 500 chances in a million.

Top Ten Air Toxics*

Diesel particulate matter
1,3 Butadiene
Benzene
Carbon Tetrachloride
Formaldehyde
Hexavalent Chromium
Para-dichlorobenzene
Acetaldehyde
Perchloroethylene
Methylene Chloride

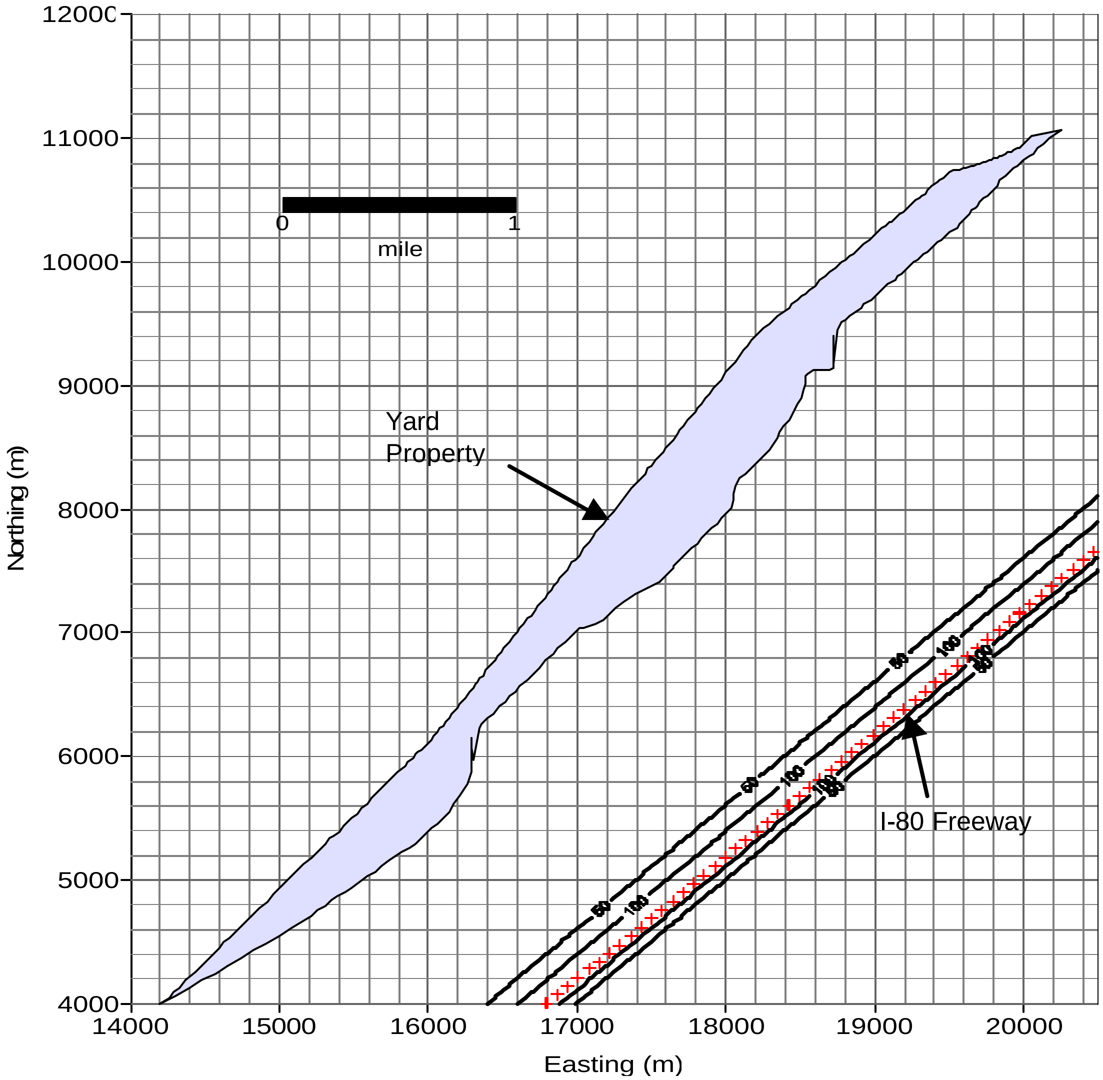
*These are the toxic air pollutants that contribute most to overall statewide risk that is measured in the ARB's monitoring network. Diesel PM is not measured, but is based on estimated values.

In addition, it may be helpful to compare the risk experienced by residents who live in close proximity to various types of facilities where many diesel engines are in use. Diesel PM is an air toxic that is released by a variety of sources. The typical risk from some of these diesel PM sources illustrate the "relative risk" when comparing activities. For example, a truck stop that has a high number of diesel trucks may result in an estimated risk as high as 200 chances in a million for nearby residents.[1] At a big distribution center where hundreds of diesel trucks operate, the risk could be as high as 750 chances in a million.[2]

To put this in a local perspective, the estimated risk from the diesel truck traffic on Interstate 80 in Roseville is shown in Figure 3. The amount of truck traffic driven daily on Interstate 80 is estimated to be about 10,000 heavy-duty diesel trucks per day based on 2002 activity data. The area of risk greater than 10 in a million is about one mile from the freeway (data not shown). The risk level at 300 feet from the edge of the freeway is about 100 in a million.[3]

[1] In July 2004, the ARB adopted an In-Use Diesel Truck Idling regulation that will reduce truck idling by 80 percent.
[2] In February 2004, the ARB adopted a Transport Refrigeration Unit (TRU) regulation that will reduce diesel PM emissions from TRUs by over 90 percent.
[3] The dispersion of diesel PM emissions was treated as an area source with urban dispersion coefficients using the USEPA ISCST3 model.

Figure 3
Estimated Risk from Diesel Truck Traffic on Interstate 80 at Roseville, CA



Note: Estimated Diesel PM Cancer Risk - 50/ and 100/million Contours from Freeway I-80 in Roseville (Roseville Meteorological Data, Urban Dispersion Coefficients, 80th Percentile Breathing Rate, EF = 0.293 g/v-mi [EMFAC2002, Y2004 Fleet], Diesel Truck Traffic = 10,000 vpd, 70-Year Exposure)

Uncertainty in Risk Assessment

The estimated diesel PM concentrations and risk levels produced by a risk assessment are based on several assumptions, many of which are designed to be health protective so that potential risks to individuals are not underestimated. Therefore, the actual risk calculated by a risk assessment is intentionally designed to avoid underprediction. There are also many uncertainties in the health values used in the risk assessment. Some of the factors that affect the uncertainty are discussed below.

When available, as is the case with diesel PM, scientists will use studies of people exposed at work to estimate risk from environmental exposures. The occupational exposures in these studies are usually much higher than environmental exposures encountered by the general public. In addition, scientists often do not have enough information to be able to predict how a chemical may affect any one person because we are unique and respond differently. Also the actual worker exposures to diesel PM were not measured but were derived based on estimates of emissions and duration of exposure. Different studies suggest different levels of risk. When the ARB's Scientific Review Panel (SRP)[4] identified diesel PM as a toxic air contaminant, they considered a range of inhalation cancer potency factors (1.3×10^{-4} to 2.4×10^{-3} $(\mu g/m^3)^{-1}$) and recommended that a risk factor of 3×10^{-4} $(\mu g/m3)^{-1}$ be used as a point estimate of the unit risk. From the unit risk factor an inhalation cancer potency factor of 1.1 $(mg/kg\text{-}day)^{-1}$ may be calculated.

As mentioned above, there is no direct measurement technique for diesel PM. For this analysis, an air dispersion model was used to estimate the concentrations that the public is exposed. The air dispersion models use a variety of information, all of which can affect the final results. All of these factors make up the “uncertainty” in the risk assessment.

[4] The Scientific Review Panel (SRP/Panel) is charged with evaluating the risk assessments of substances proposed for identification as toxic air contaminants by the Air Resources Board (ARB) and the Department of Pesticide Regulation (DPR). In carrying out this responsibility, the SRP reviews the exposure and health assessment reports and underlying scientific data upon which the reports are based, which are prepared by the ARB, DPR, and the Office of Environmental Health Hazard Assessment (OEHHA) pursuant to the sections 39660-39661 of the Health and safety Code and sections 14022-14023 of the Food and Agriculture Code. These reports are prepared for the purpose of determining whether a substance or pesticide should be identified as a toxic air contaminant.

Roseville Rail Yard Study Part II: Health Risk Assessment

Health Risk Assessment for the Union Pacific Railroad's J.R. Davis Yard Roseville, California

I. EXECUTIVE SUMMARY

At the request of the Placer County Air Pollution Control District (District), the California Air Resources Board (ARB or Board) conducted a health risk assessment of airborne particulate matter emissions from diesel-fueled locomotives at the Union Pacific J.R. Davis Yard (Yard) located in Roseville, California. Union Pacific Railroad Company (UP) assisted in the project by providing extensive information on facility operations and emissions.

The purpose of this Roseville Rail Yard Study Part II: Health Risk Assessment, is to provide a detailed assessment of the potential health risk near the Yard due to diesel particulate matter (diesel PM) emissions from locomotives.[5] The risk assessment included developing an inventory of diesel PM emissions at the Yard, conducting computer modeling to predict increases in the ambient air concentrations of diesel PM in the surrounding community due to locomotive activity, and assessing the potential cancer risks from exposure to the predicted ambient air concentrations of diesel PM. As a reminder, Part I of the Roseville Rail Yard Study, entitled "Risk Characterization" explains the results from the risk assessment in less technical and more easily understood terms. Part I also compares the predicted cancer risk from the Yard to other individual sources of diesel PM emissions, as well as to the overall cancer risk produced by airborne toxic compounds in California.

Presented below is a summary of the key findings of the study followed by an overview that briefly discusses how the exposure and risk assessments were performed to evaluate potential cancer risks from exposure to diesel PM from locomotive activities at the J.R. Davis Rail Yard. For simplicity, the overview discussion is presented in question-and-answer format. The reader is directed to subsequent chapters in Part II for more detailed information.

A. Summary of Findings

To summarize, the key findings of the study are:

- The diesel PM emissions in 2000 from locomotive operations at the Yard are estimated to be about 25 tons per year.
- Moving locomotives account for about 50 percent, idling locomotives account for about 45 percent, and locomotive testing accounts for about 5 percent of the total diesel PM emissions at the Yard.

[5] Diesel PM was identified as a toxic air contaminant by the ARB in 1998.

- Computer modeling predicts potential cancer risks greater than 500 in a million (based on 70 years of exposure) northwest of the *Service Track* area and the *Hump and Trim* area. The area impacted is between 10 to 40 acres.
- The risk assessment shows elevated concentrations (= 10 in a million) of diesel PM and associated cancer risk impacting a large area. These elevated concentrations, which are above the regional background level, of diesel PM contribute to an increased risk of cancer and premature deaths due to cardiovascular disease and non cancer health effects such as asthma and chronic obstructive pulmonary disease. Potential cancer risk and the number of acres impacted for several risk ranges are as follows:
  - ✓ Risk levels between 100 and 500 in a million occur over a 700 to 1600 acre area in which about 14,000 to 26,000 people live.
  - ✓ Risk levels between 10 and 100 in a million occur over a 46,000 to 56,000 acre area in which about 140,000 to 155,000 people live.

- The magnitude of the risk, the general location of the risk, and the size of the area impacted varies depending on the meteorological data (Roseville or McClellan), the dispersion characteristics (urban or rural), the assumed exposure duration (70 or 30 years) and the breathing rate (95^{th}, 80^{th}, and 65^{th} percentile).

B. Overview

1. What are exposure and risk assessments?

An exposure assessment is an analysis of the amount (concentration) of a substance that a person is exposed to during a specified time period. This information is used in a risk assessment to evaluate the potential for a chemical to cause cancer or other health effects. Mathematical models are used in both exposure and risk assessments to evaluate the potential health impacts from exposure to chemicals. The input to the mathematical models used to estimate potential health risk for substances emitted in to the air includes data and assumptions regarding:

- the magnitude and duration of the diesel PM emissions,
- the weather, (i.e. meteorology),
- human behavior patterns (i.e. the length of time someone is exposed), breathing rate, body weight
- and the toxicity of the substances.

The predicted concentrations and health impacts (e.g., cancer risk) presented in a site-specific health risk assessment are assumed to exist in excess of background concentrations or resulting health risks. For an individual person, cancer risk estimates are commonly expressed as a probability of developing cancer from a lifetime (i.e., 70 years) of exposure. Cancer risks are typically expressed as “chances per million”.

For example, if the cancer risk were estimated to be 100 chances per million, then the probability of an individual developing cancer would be expected to not exceed 100 chances in a million. If a population (e.g., 1 million people) were exposed to the same potential cancer risk (e.g., 100 chances per million), then statistics would predict that no more than 100 of those million people exposed are likely to develop cancer from a lifetime of exposure (70 years) due to diesel PM emissions from the Yard.

While there are inherent uncertainties in each of the variables, mentioned above, risk assessments are an effective tool to help assess an exposed populations relative risk from exposure to a toxic air contaminant. However, because there are inherent uncertainties in each of the variables that go in to a risk assessment, one needs to recognize that there is considerable uncertainty in estimating the risk for a specific individual or at a specific location. Generally, risk assessment results should not be considered as exact estimates of a specific individual’s risk. Risk assessment results are best used to compare the relative risk between one facility and another and for comparing potential risks to target levels to determine the level of mitigation needed. They are also an effective tool for determining the impact a particular control strategy will have on reducing risk.

2. Why did ARB staff conduct an assessment of the J.R. Davis Rail Yard?

The ARB staff conducted an assessment of the J.R. Davis Rail Yard at the request of the Placer County Air Pollution Control District (District). After a recent expansion at the Yard, the District received a significant increase in noise and diesel exhaust emission-related complaints from residents of the City of Roseville that live near the J.R. Davis Rail Yard. To address the growing concerns of nearby residents and to better understand the diesel particulate matter (PM) emission impacts and the related health effects, and to determine if mitigation measures are needed, the District requested the ARB to prepare an exposure assessment of diesel PM emissions and its related heath impacts generated by activities at the J.R. Davis Rail Yard. To the ARB staff's knowledge, no comparable assessment of a similar facility has been prepared and reported in available literature.

3. Why is ARB concerned about Diesel PM?

Diesel engines emit a complex mixture of air pollutants, composed of gaseous and solid material. The visible emissions in diesel exhaust are known as particulate matter or PM, which includes carbon particles or "soot". In 1998, ARB identified diesel PM as a toxic air contaminant based on its potential to cause cancer, premature deaths, and other health problems. Health risks from diesel PM are highest in areas of concentrated emissions, such as near ports, rail yards, freeways, or warehouse distribution centers. Exposure to diesel PM is a health hazard, particularly to children whose lungs are still developing and the elderly who may have other serious health problems.

Health impacts from exposure to the fine particulate matter ($PM_{2.5}$) component of diesel exhaust have been calculated for California, using concentration-response equations from several epidemiologic studies. Both mortality and morbidity effects have been associated with exposure to either direct diesel $PM_{2.5}$ or indirect diesel $PM_{2.5}$, the latter of which arises from the conversion of diesel NO_x emissions to $PM_{2.5}$ nitrates. It was estimated that 2000 and 900 annual premature deaths resulted from exposure to either

1.8 $\mu g/m^3$ of direct diesel $PM_{2.5}$ and 0.81 $\mu g/m^3$ of indirect diesel $PM_{2.5}$, respectively, for the year 2000. The mortality estimates are likely to exclude cancer cases, but may include some premature deaths due to cancer, because the epidemiologic studies did not identify the cause of death. Exposure to fine particulate matter, including diesel $PM_{2.5}$ can also be linked to a number of heart and lung diseases. For example, it was estimated the 5,400 hospital admissions for chronic obstructive pulmonary disease, pneumonia, cardiovascular disease and asthma were due to exposure to direct diesel $PM_{2.5}$ in California. An additional 2,400 admissions were linked to exposure to indirect diesel PM (Lloyd. 2001)

4. Where is the J.R. Davis Rail Yard located and what locomotive activities occur there?

The Yard occupies about 950 acres, on a one-quarter mile wide by four-mile long strip of land that parallels Interstate 80, near the City of Roseville, California. Approximately two-thirds of the area of the Yard is located in Placer County with the remaining one-third in Sacramento County. Downtown Roseville and residential neighborhoods are located along the southern side of the Yard. On the northern side are residential areas as well as industrial zones. In the southeast, however, it is predominantly residential neighborhoods. As you move away from the Yard to the northwest, the area becomes more rural in nature. The J.R. Davis Rail Yard has been operating in the City of Roseville since 1905. At the Yard, trains are classified (locomotives and train cars are connected or taken apart) and locomotives undergo routine maintenance, servicing, and repair.

About 31,000 locomotives stopped at the Yard during the year in which UPRR collected statistics for the ARB. Another 15,000 locomotives used the Northside Tracks (through trains) during this period. These locomotives have very large diesel-fueled engines. Locomotive engines generally last 30 to 40 years. Because more effective emission standards for locomotive engines have only recently been promulgated by the U.S. Environmental Protection Agency (U.S. EPA), and are just now being phased in, emissions of both diesel PM and oxides of nitrogen (NOx) from locomotives remain very high relative to many other sources.

5. What are the diesel PM emissions from locomotive activities at the J.R. Davis Rail Yard?

The emissions of diesel PM from locomotive activities at the Yard in 2000 were estimated to be approximately 22 to 25 tons per year. About 50 percent of the diesel PM emissions are from locomotives moving through the different areas in the Yard, about 45 percent are from idling locomotives, and approximately 5 percent are from locomotives undergoing testing.

By area, the *Service Area* (the area around the maintenance shop) had the highest diesel PM emissions, about 8 tons per year. The *Service Area* is located at about the mid-point of the Yard on the northern side (See Figure II-1 on page 20). In the *Service Area*, the predominant source of emissions, about 75 percent of the total, is from idling locomotives. The *Hump Area* and *Trim Area* had the next highest emissions, with 7.5 tons per year diesel PM.

6. How were the diesel PM concentrations near the Roseville Rail Yard estimated?

ARB staff used the U.S. EPA approved computer model (ISCST3) to estimate the annual average offsite concentration of diesel PM resulting from locomotive activity at the Yard. The key inputs to the computer model were the diesel PM emissions information (both magnitude, timing, and location), the meteorological data (wind speed and direction), and the dispersion coefficients (rural or urban). The emissions inventory was developed working closely with Union Pacific Rail Road and the District. This inventory represents the most complete inventory for the J. R. Davis Yard and is based primarily on year 2000 data.

Two different sets of historical meteorological data were used in this analysis to estimate the dispersion and transport of diesel PM emissions from the Yard. One set, the Roseville meteorological set, was from a site about a mile from the Yard. The second set, the McClellan meteorological set, was from a site about 10 miles from the Yard. Since the area surrounding the Roseville Rail Yard has both urban and rural characteristics the modeling was also done using both the urban and rural dispersion coefficients. Based on current land use patterns near the Yard, ARB staff elected to use urban dispersion characteristics within one mile of the Yard and rural dispersion characteristics beyond one mile from the Yard.

7. How were the potential cancer risks from diesel PM estimated?

The potential cancer risks were estimated using standard risk assessment procedures based on the annual average concentration of diesel PM predicted by the model and a health risk factor (referred to as a cancer potency factor) that correlates cancer risk to the amount of diesel PM inhaled.

The methodology used to estimate the potential cancer risks is consistent with the Tier-1 analysis presented in the OEHHA, Air Toxics Hot Spots Program Risk Assessment Guidelines (September 2003). A Tier 1 analysis assumes that an individual is exposed to an annual average concentration of a pollutant continuously for 70 years.[6] A more refined risk assessment (Tier 2) can be performed when additional site specific information concerning the exposed population is available. However, in most cases, adequate site specific information about the exposed population was not available. This was the case in the Roseville Study. The cancer potency factor was developed by the Office of Environmental Health Hazard Assessment (OEHHA) and approved by the SRP as part of the process of identifying diesel exhaust emission as a toxic air contaminant (TAC). Diesel PM was identified as a TAC in 1998 after 10 years of extensive investigation.

[6] According to the OEHHA Guidelines, the relatively health-protective assumptions incorporated into the Tier 1 risk assessment make it unlikely that the risks are underestimated for the general population.

8. What are the results?[7]

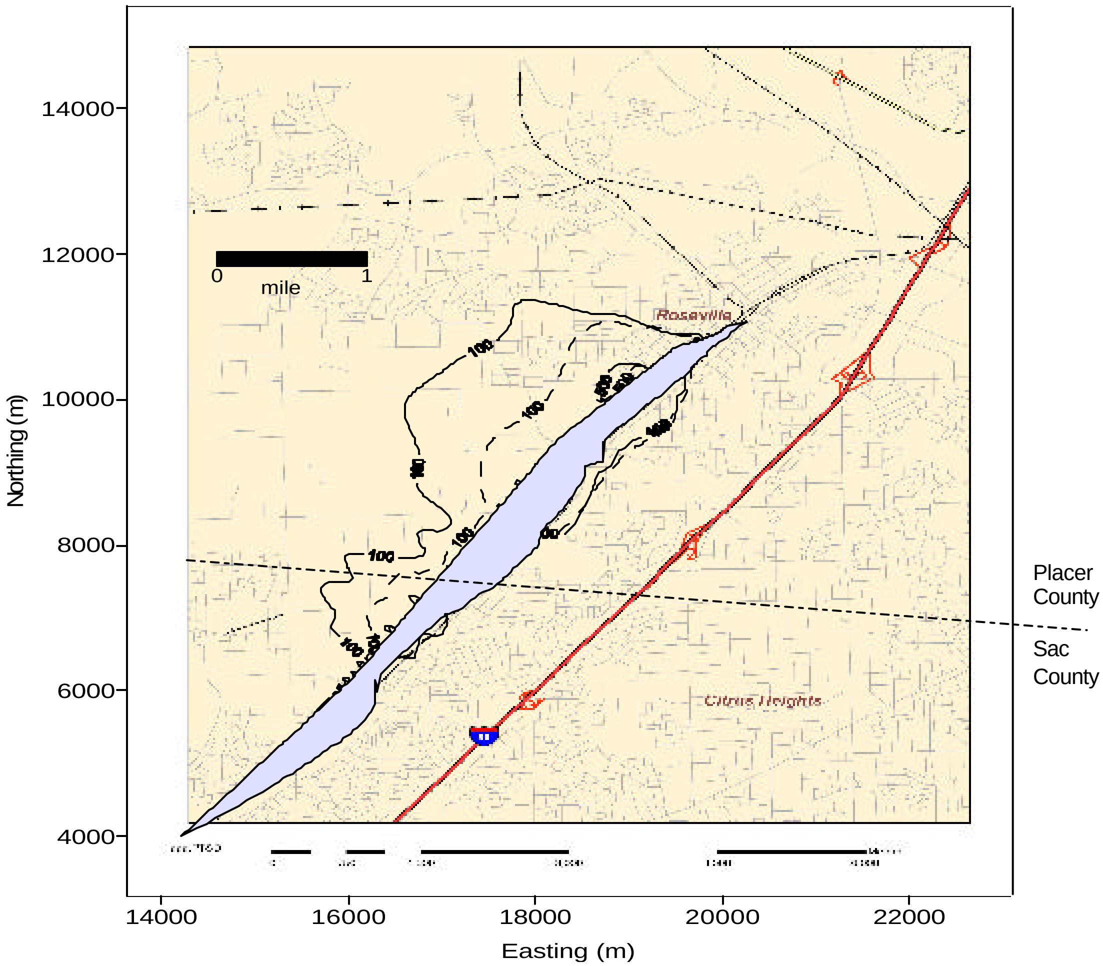
The potential cancer risk from the estimated emissions of diesel PM at the Yard were calculated using two meteorological data sets (Roseville and McClellan) and for both urban and rural dispersion characteristics.[8]

Figure I.1 presents the predicted 100 and 500 in a million cancer risk isopleths for the two meteorological sets (Roseville and McClellan) using the urban dispersion characteristics. ARB staff believes that the urban dispersion characteristics are most appropriate for predicting the near source impacts from the Yard and the rural dispersion characteristics are most appropriate for predicting the area-wide impacts. The solid line represents the 100 or 500 in a million cancer risk isopleth using the Roseville meteorological data. The dashed line represents the 100 or 500 in a million cancer risk isopleth using the McClellan meteorological data. The area inside the isopleth has potential cancer risks estimated to be greater than 100 or 500 in a million depending on the isopleth. For example, the number of acres with predicted cancer risk levels at 100 in a million or more is approximately 1600 acres using Roseville meteorological data and 700 acres using McClellan meteorological data.

[7] All estimated cancer risks reported in the Executive Summary are based on the 80th percentile breathing rate that is the midpoint of the range of risk calculated in the risk assessment. The main body of Part II provides the more detailed information on the entire range of risk, which is calculated using the 65th to 95th percentile breathing rates.

[8] Dispersion coefficients are used in air dispersion models to reflect the land use (rural or urban) over which the pollutants are transported. The rural dispersion coefficient generally results in wider dispersion of the pollutant hence a larger "footprint" whereas an urban coefficient results in less dispersion of the pollutant and a smaller footprint. Because the area around the Yard contained both urban and rural land use types, the model was run with both dispersion coefficients.

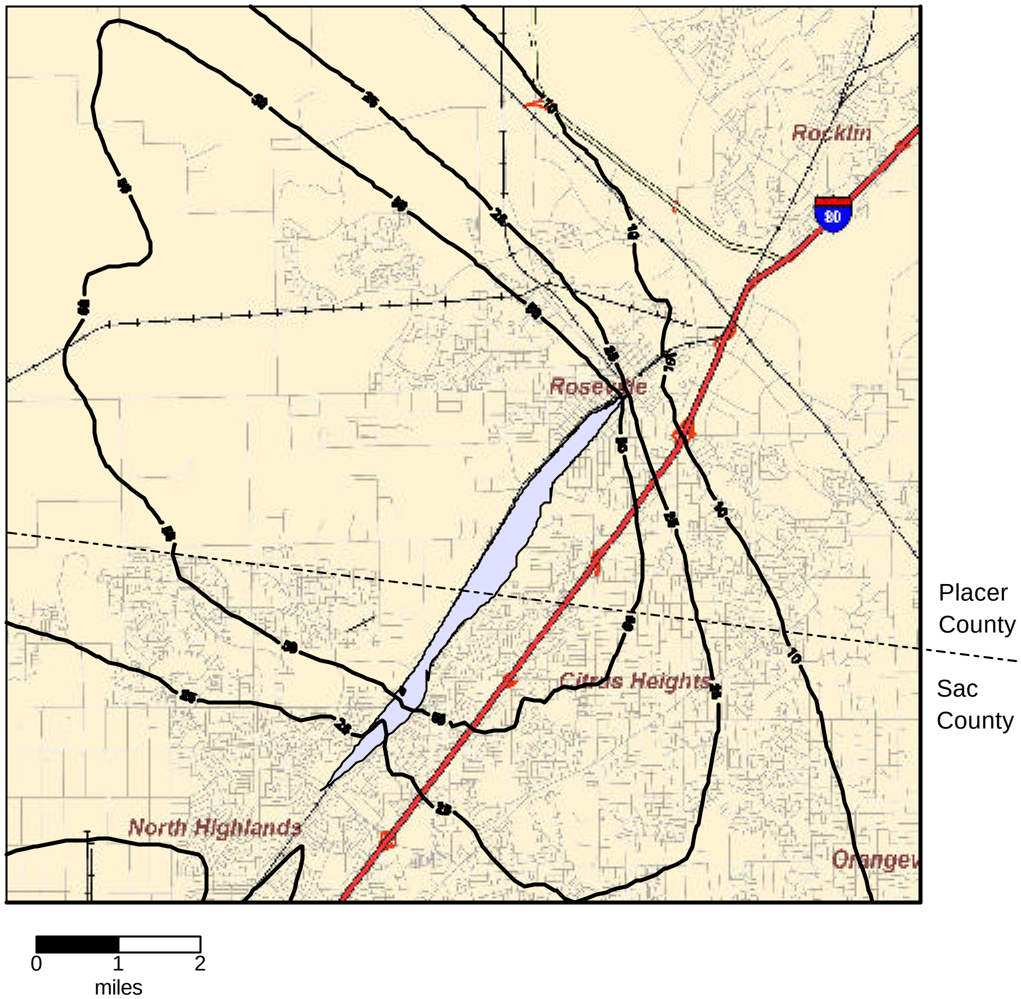
Figure I.1: Estimated Cancer Risk from the Yard (100 and 500 in a million risk isopleths)



Notes: 100/Million Contours: Solid Line – Roseville Met Data; Dashed Line-McClellan Met Data, Urban Dispersion Coefficients, 80th Percentile Breathing Rate, All Locomotives' Activities (23 TPY), 70-Year Exposure

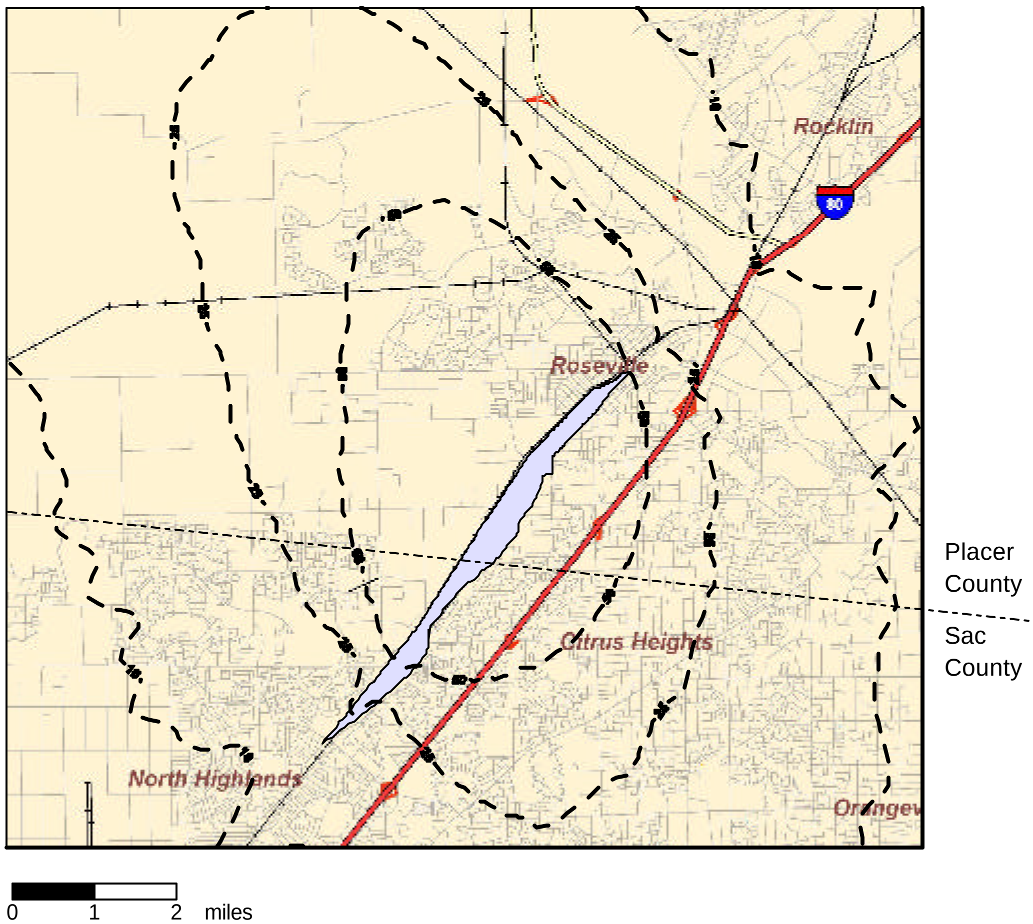
Figures I.2a and 1.2b present the potential risk for the two different meteorological data sets using the rural dispersion coefficient. As stated previously, staff believes that the rural dispersion characteristics are most appropriate for predicting the area-wide source impacts from the Yard. The isopleths for 10, 25, and 50 in a million potential cancer risk are shown. Figure 1.2a provides the estimated cancer risk isopleths using the Roseville meteorological data and Figure 1.2b the results using the McClellan meteorological data. As can be seen in the figures, the area in which the risks are predicted to exceed 10 in a million is very large, covering about a 10 mile by 10-mile area. The estimated number of acres, including areas outside of the modeling area, with a predicted cancer risk of 10 in a million or greater is in excess of 55,000 acres.

Figure I.2a: Estimated Cancer Risk from the Yard Using Roseville Met Data (10, 25, and 50 in a million risk isopleths)



Notes: Roseville Meteorological Data, Rural Dispersion Coefficients, 80th Percentile Breathing Rate, All Locomotives' Activities [23 TPY], 70-Year Exposure

Figure I.2b: Estimated Cancer Risk from the Yard Using McClellan Met Data (10, 25, and 50 in a million risk isopleth)



Notes: McClelln Meteorological Data, Rural Dispersion Coefficients, 80th Percentile Breathing Rate, All Locomotives' Activities [23 TPY], 70-Year Exposure

Using the U. S. Census Bureau's year 2000 census data, we estimated the population within the isopleth boundaries.[9] As shown in Table I.1, over 165,000 people live in the area around the Yard that has predicted risks of greater than 10 in a million. Also shown in Table 1.1 is the average risk level within each risk zone. For example the average risk within the ≥ 500 Roseville risk zone is 645 in a million.

Table I.1: Summary of Average Risk by Risk Zone and Acres Impacted

Meteoro-logical Data Source	**Risk Zone Based on Figures 1.1 and 1.2a and b Isopleth Boundaries** (70 Year Exposure)	Dispersion Characteristic	Average Risk Estimated Based on Years Exposed 70 years	Acres Impacted (rounded)	Estimated Year 2000 Population
Roseville	Risk ≥ 500	Urban	645	40	685
	Risk ≥ 100 and < 500	Urban	170	1,600	25,800
	Risk ≥ 10 and < 100	Rural	40	45,900	139,000
	Total			47,500	165,000
McClellan					
	Risk ≥ 500	Urban	630	10	460
	Risk ≥ 100 and < 500	Urban	156	700	14,200
	Risk ≥ 10 and < 100	Rural	28	55,500	155,000
	Total			56,200	169,000

Notes: Model domain for rural dispersion coefficient is 16km x 18 km with a resolution of 200m x 200m. For the urban dispersion coefficient the model domain is 6km x 8 km with a resolution of 50m x 50m. The 80th percentile breathing rate for adults was used.

Figures I.1 and I.2a and b are based on an exposure duration of 70 years. OEHHA guidelines recommend a 70-year exposure duration for a Tier 1 evaluation. The OEHHA guidelines also provide that a 30-year exposure duration may also be evaluated as supplemental information to show the range of cancer risk based on different residency periods. Table I.2 shows the equivalent risk level for 70- and 30-year exposure duration. Using this table, the 10 in a million isopleth line in Figures I.2 a and b would become 4.3 in a million if the exposure duration was 30 years for an adult.

Table I.2: Equivalent Risk Levels for 70 and 30-Year Exposure Duration

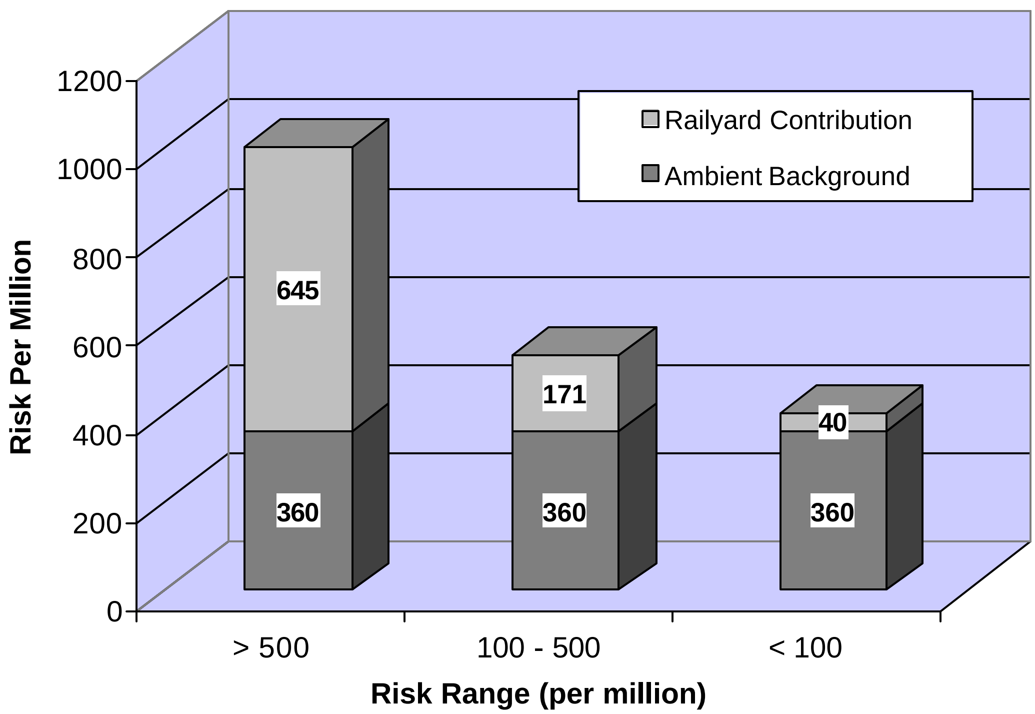
Exposure Duration (years)	Equivalent Risk Level (chance in a million)		
70	10	100	500
30	4.3	43	215

The estimated concentrations of diesel PM due to emissions from the rail yard are in addition to regional background levels of diesel PM. Although emissions from the rail

[9] To estimate the population, a GIS map of the model domain was overlaid with the 2000 census tract boundaries, and the percentage area of a given census tract within an isopleth was determined. The population of the census tract was then weighted with the percentage area of that census tract within the isopleth.

yard also contribute to the regional background, the measurable effect should be small. The regional background risk due to diesel PM emissions has been estimated to be 360 per million for the entire Sacramento Valley in the year 2000. Figure 1.3 provides a comparison of the predicted average potential cancer risk in various isopleths to the regional background risk from diesel PM. For example, in the greater than 500 isopleth or risk range, the average risk above the regional background is 645. Residents living in that area would have a potential cancer risk over 1,000. (645 per million due to rail yard emissions and 360 per million for regional background) (ARB 2004).

Figure 1.3: Comparison of Roseville Rail Yard Risks to the Regional Background Levels in the Sacramento Region for Diesel PM



Note: Roseville Meteorological Data, Urban Dispersion Coefficients for Risk Ranges of > 500 and 100-500, Rural Dispersion Coefficients for Risk Range of < 100.

9. Has monitoring been conducted to verify the model predictions.

No. Currently there is no specific measurement technique for directly monitoring diesel PM emissions in the ambient air. However this does not preclude the use of an ambient monitoring program to measure general air quality trends in a region. However, surrogate tests using elemental carbon can be very expensive. Since cancer risk is based on an annual average concentration, a minimum of a year of monitoring data would generally be needed. A monitoring study to validate the modeling results using elemental carbon would involve numerous monitors operating for at least a year. The cost of such a program is likely to be quite high, ranging from several hundred thousand to possibly several million dollars to complete. Past studies have used black carbon or elemental carbon measurements along with detailed emissions inventories to draw conclusions about the relative contributions of diesel PM emissions. As such, PM 2.5 elemental carbon monitoring can provide general information on combustion-related particulate matter in a region.

10. Have the diesel PM emissions at the Yard changed since 2000, the year for which the health risk assessment was conducted?

Without additional data, it is difficult to determine the emissions trends at the Yard since the year 2000. According to Union Pacific Rail Road, several actions have been taken to modify their locomotive fleet and operations at Roseville in ways that could decrease emissions associated with many locomotive activities. Some of the actions taken include replacing older locomotives with Tier 0 or better locomotives, installation of auto start-stop devices to limit idling, fuel efficiency improvements, modification of load test procedures, and operation efficiency improvements. While the exact diesel PM emissions benefits at the Yard have not been determined, UP indicates that they believe these efforts have resulted in actual emission reductions at the Yard. On the other hand, California has experienced a tremendous increase in the volume of cargo being moved through our Ports that could potentially result in additional rail traffic and diesel PM emissions. For example, based on fuel consumption data provided by the two Class 1 freight railroads operating in California, there was a 4 percent per annum increase in fuel consumption between 1998 and 2002. (BNSF & UP. 2004). Because of this, a more extensive analysis of the projected growth in activity and the impacts from emission reduction strategies is needed to determine if the emissions at the Yard have changed since 2000 and determine the degree to which emission reduction actions have offset the increased emissions due to growth in locomotive activities at the Roseville Yard.